THE AMERICAN JOURNAL
OF
OPHTHALMOLOGY.

VOL. XX. JUNE, 1903. No. 6.

ORIGINAL ARTICLES.

AN EXPOSITION OF THE PRINCIPLES OF REFRACTION IN THE HUMAN EYE, BASED ON THE LAWS OF CONJUGATE FOCI.

With 17 Original Illustrations.

BY SWAN M. BURNETT, M. D., PH. D.,
Professor of Ophthalmology and Otology in the Medical School of the University of Georgetown.

WASHINGTON, D. C.

(Continued from last issue).

In determining the refraction of the eye by skiascopy, we employ the same principles as in all the other methods, namely, by finding the far point of the eye, or the conjugate focus of the fundus. This is not done, however, by determining directly the place where the nodal point of the observing eye and the conjugate focus of the fundus of the observed eye fall together. Since this is at infinity in E and negative in H, it would not be practically possible. Nor is it necessary, since we can artifically bring the far point of any eye to any desired finite distance by the interposition of a lens in the path of the emerging rays, as is done in the indirect ophthalmoscopic method. In other words we can create an artifical myopia at whose far point we can easily place the nodal point of the observing eye, and obtain the phenomena of reversal. Let us suppose that this fixed far point is at 1 *meter* (M=1D) where the observing eye finds itself. The far point of any eye can be brought by means of a proper lens placed just in

front of it to this point of reversal, and the difference between the actual far point of this eye and 1D of M is given by the strength of the auxiliary lens which it is found necessary to place in the path of the rays in order to bring that far point to 1m. The far point of the observed eye is therefore expressed by the difference between the number (x) of the lens and 1D, or x—1 dioptries of refraction, from which the position of the far point is easily found.

Examples:—The observing eye being at 1m. and a lens $x = +$ 1D. being necessary to bring about a reversal of movement, there is emmetropia, since x—1 $= +$ 1—1 $= 0$ dioptries of refraction. Hence the far point $= \frac{1 \text{ Meter}}{0} = \infty$ (infinity). If +0.5D is required, then there is +0.5—1=—0.5 with a far point $\frac{1 \text{ M}}{0.5}$ at 2 meters, and there is M of 0.5D. If a +4D is found necessary to bring about a reversal, there is +4—1=+3D of H, with a negative far point $\frac{1 \text{ M}}{3}$ at 33 cm. behind the observed eye. Should a —3D be required to bring about a reversal, there is —3—1 = —4D of M with the far point at $\frac{1 \text{ m}}{4} = 25$ cm. in front of the observed eye, —3D being necessary to extend the far point from 25 cm. (4D) to 1m. (1D). Should the nodal point of the observing eye be placed at 2m. in front of the observed eye, we would have to substitute 0.5D for 1D in the above calculations. If it be at one half a meter, 2D will have to be substituted, etc.

In this method the *accommodation of the observed eye* can, by its action, modify the position of its far point by bringing it nearer, thus increasing the M and adding some dynamic to the static refraction. On the contrary, an *accommodation on the part of the observing eye can have but little effect*, since the amount of accommodation used to fix the pupil of the observed eye, does not materially displace the nodal point of the observer's eye from the actual position of the point of reversal.

Skiascopy With the Concave Mirror: The difference between this method and that with the plane mirror rests on the difference in the positions of the flame image giving the illumination. With the plane mirror, as we have seen, the flame image is as far behind the mirror as the flame is in front of it, and moves always against the mirror rotation. With the *concave mirror the flame image is at the focus of the*

mirror in front of the observer and moves always with the mirror rotation. As a result of this the direction of movement of the bright spot across the fundus of the observed eye with the concave mirror is the *opposite of that* of the flame image and of the mirror rotation, and necessarily the contrary of that with the plane mirror. The direction of the movement of the image of the bright spot at the conjugate focus of the eye, however, remains the same, that is, contrary to that of the bright spot itself, in the case of E and M where the movement is *with* the mirror rotation, while in H it is *against* it. When the observer, then, is at a sufficient distance from the eye under observation to allow the flame image to be formed in front of the observed eye, the phenomena of movements apparent to the observer will be the reverse of those with a plane mirror. In E and H and in M with a far point behind the nodal point of the observer's eye, the movement will be *against* the mirror rotation, in M with the far point in front of the nodal point of the observer's eye, the movement will be *with* the mirror.

With the exception of this change in the direction of the movements across the pupil, the rules for the estimation of ametropia are the same as with the plane mirror. When, however, the concave mirror is approached sufficiently near to allow the flame image to fall behind the optical center or nodal point of the observed eye, the bright spot and the flame image will move in the same direction, and the phenomena will be the same as with the plane mirror.

THE CONJUGATE FOCI IN ASTIGMIA (*) (ASTIGMATISM).

In the optical state of the eye known as astigmia (or more commonly as astigmatism), the two principal meridians at right angles to each other are of unequal refractive power and each has conjugate foci of its own which can be studied separately from those of the other. These two foci, conjugate to the retina, are on planes perpendicular to the visual axis, which are separated the one from the other by what is called the *focal interval of Sturm.* It has been customary, hitherto, to

*This word is not derived, as is usually stated, from στιγμα-στιγματος, which means a *blemish* or *spot*, but from, στιγμη-ης, which means a *point*. Hence *astigmia* is etymologically more nearly correct than *astigmatism*, though it will probably never supplant the term so long in use.

consider the focal interval of Sturm as applied solely to the two posterior conjugate foci in their relations to the retina, the anterior conjugate focus being fixed at infinity.

Astigmatism has been divided in accordance with this view into; 1. *simple astigmatism*, in which one focus is on the retina, E, Fig. XIII., and the other either (*a*) in front of the

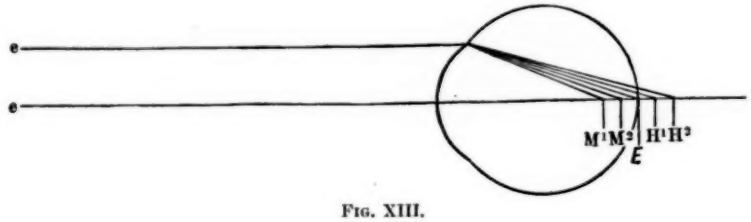

Fig. XIII.

retina M^2, (myopic astigmatism), or (*b*) behind the retina H^1 (hypermetropic astigmatism); 2. *compound myopic astigmatism*, where both foci M^1, M^2 are in front of the retina; 3. *compound hypermetropic astigmatism* where both foci H^1 H^2 are behind the retina; 4. *mixt astigmatism*, where one focus M^2, is in front of, and the other H^1, is behind the retina.

In keeping with our general plan, however, we can with equal propriety regard *the focal interval of Sturm as separating the other conjugate foci, the position of the retina remaining fixed.* The dimensions and position of the interval of Sturm on the visual axis, outside the eye, must vary, therefore, with the varying position of the conjugate foci of the two mer-

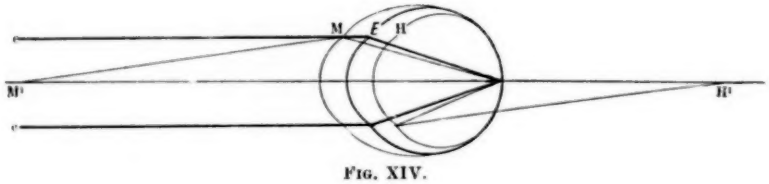

Fig. XIV.

idians, in respect to the principal plane of the eye as in ordinary spherical refraction.

Studying them, then, from this standpoint we have: 1. The conjugate focus of one meridian at infinity *e e* Fig. XIV., the other at a finite distance M^1, *simple M astigmatism*. 2. One conjugate focus at infinity *e e*, the other behind the refracting system at H^1, *simple H astigmatism*. 3. Both

conjugate foci at a finite distance, but separated by a focal interval M^1 Fig. XV., corresponding to the meridian m^1, and M^2 corresponding to the meridian m^2, *compound M astigmatism*. 4. Both conjugate foci behind the refracting system, but with a focal interval H^1 corresponding to the meridian h^1, and H^2 corresponding to h^2, *compound H astigmatism*. 5. One conjugate focus in front of the eye at M^1 Fig. XIV., the other at H^1 behind it, the focal interval being M^1 H^1, *mixt astigmatism*.

When the two conjugate foci are, by suitable optical means, brought together, the focal interval is abolished, and the astigmatism is said to be corrected. The optical agent used for this purpose is a cylindrical lens which refracts the light only in the meridian of its curvature, the light falling in the direction of its axis being unaffected. Such a lens is placed before the eye with its curvature corresponding to the meridian whose

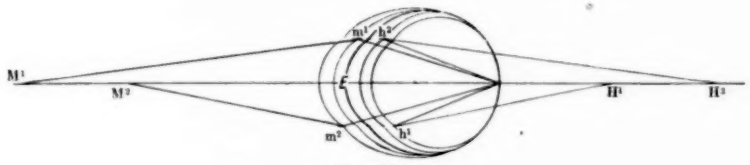

Fig. XV.

refraction it is desired to effect, and it should be of such quality and power as to bring the conjugate focus of that meridian to the same point as that of the other meridian.

Examples:—There is simple myopic astigmatism, with one conjugate focus at infinity (*e e* Fig. XIV), the other at M^1, 20 cm. in front of the principal plane. A concave cylinder with the (negative) focus of its refracting meridian at 20 cm. (−5D), placed with this meridian corresponding to the faulty meridian of the eye, (or what is the same thing, with its axis corresponding to the axis of this meridian), will render parallel rays divergent as if they came from its focus, which is, at the same time, the conjugate focus of this meridian, and thus set this conjugate focus back to infinity, where the conjugate focus of the other meridian is found. The astigmatism has now been corrected and E prevails. One meridian h^1 with its axis at 180° (horizontal), has its far point, Fig. XV, at 50 cm. ($H^2 = 2D$), and the other, h^2, with its axis at 90°

(vertical), 20 cm. behind the refracting system, $H^2 = 5D$. The focal interval is then represented by the difference in the focus of the two lenses, representing these two foci: $+5 - +2 = +3D$. A +3 cylinder, then, with its axis at 90° corresponding to the axis of the meridian of least refraction will remove the focus of this meridian from 20 cm. (+5) back to 50 cm. (+2), and the focal interval will be abolished and the astigmatism corrected. The common conjugate focus, however, still remains at 50 cm., H^2, behind the eye, and there will be yet a H of 2D present which can be overcome and the eye rendered emmetropic by a spherical lens which acts upon both meridians equally, and of such power as to shift the conjugate focus from 50 cm. back to infinity. The strength of this spherical lens is +2D, which must be added to the cylinder (+3) in order to correct the total ametropia; the formula for the glass being +2⌒+3. 90°. One meridian has its far point at M^1 Fig.XIV, (M=2D), and the other at H^1, (H=3D). The astigmatism M^1 H^1 is therefore =3+2=5D (3 being negative). As the H is negative, it will require a +3D cylinder to bring H^1 to infinity, for this meridian, while it will require a —2D to bring the conjugate focus of M^1 to infinity in the meridian at right angles to it. If the axis of H is at 90° and that of M at 180°, the formula for the correcting lens would be +3 axis 90°⌒—2 axis 180 .

Determination of Astigmatism by Skiascopy. The movement of the bright spot on the fundus being necessarily in the same plane as the mirror movement (at right angles to its rotation axis), it is only the refraction in a single meridian corresponding to that plane that is determined in skiascopy. As it is possible, however, to make the axis of mirror rotation correspond to any meridian of the refracting system, it is desired to examine, it is easy to determine separately the refraction in any two meridians at right angles to each other as we have it in astigmatism. To this end, it is only necessary to find the separate points of reversal for the meridians of least and greatest refraction, (always at right angles to each other), to know the value of the focal interval of Sturm. Knowing, then, the far points of the two meridians, the strength of the cylindrical lens required to bring them together marks the degree or amount of astigmatism.

Example:—Meridian with its axis at 90° requires +3 to bring about a reversal at 1 M, that with its axis at 180° requires a +2. There is, therefore, 1D of H, with its axis at 180°, and 2D of H, with its axis at 90°. The astigmatism is therefore +2—1=+1D axis 90°, with a general H of 1D common to both meridians (compound H astig.)

Determination of Astigmatism by the Ophthalmoscope. In the determination of general ametropia by means of the ophthalmoscope (direct method), we saw that when the two retinæ were brought into the positions of conjugate foci, and the details of the fundus of the observed eye were pictured distinctly upon the retina of the observing eye, the ametropia was abolished, and the focus of the lens through which this was effected, marked the far point of the observed eye (the observing eye being emmetropic). In astigmatism, there being two foci, corresponding to the meridians of least and greatest refraction at right angles to each other, it is necessary to determine the conjugate focus or far point of each of these meridians separately. This is done by taking as the objects of observation, the retinal vessels running in various directions across the background of the eye. In astigmatism the vessels whose general course corresponds to one direction will be seen more distinctly than those running in a direction at right angles to this. These directions will correspond to the *axes* of the two principal meridians, respectively. It now remains to find the lens through which the vessels corresponding to the axis of each of these meridians are seen most distinctly, separately, and the difference in their power will express the amount of astigmatism.

Example:—The vessels running in a vertical direction are seen most distinctly with a +3D, while those running in a horizontal direction are seen distinctly with a +1D. There is then H=3D with the axis at 90° (vertical), and H=1D with the axis at 180° (horizontal). There is then a general H=1D and an astigmatism of 3—1=2D axis 90°.

APPENDIX.

In order that the action of these laws governing the refraction of the eye, in the various manners described in the foregoing thesis, may be brought together under a general

mathematical formula applicable to all possible conditions, we add an exposition, based on the simple formulæ for conjugate foci given by Gavarret, (*Les images par reflexion et refraction*). In this treatment we accept as fixed values, the optical constants of the reduced eye of Donders, where the posterior principal focus for parallel rays A F^1 (Fig. XVI.), $=f^1=20$ *mm.*, and the anterior principal focus A $F=f=15$ *mm.* B and C indicate the positions of other conjugate foci, and the relation of these to the principal foci F and F^1 have the values l and l^1. The varying values of l and l^1 are counted from F and F^1 in such manner that all values of l to the left of F are considered as positive (+), while all values to the right of F are negative (—). All values of l^1 to the left of F^1 are counted as negative (—), while all values to the right of F^1 are counted as positive (+). It will be seen that F^1 marks the position the retina occupies in emmetropia, being at the posterior principal focus for parallel rays.

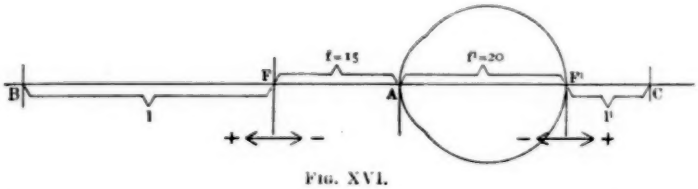

FIG. XVI.

The general formula for determining the values of l and l^1 is, $l\,l^1=f\,f^1$ (1). The values of f and f^1 being fixed, any change in the value of l must be associated with a change in the value of l^1, and *vice versa*, and in accordance with the following formulæ, deduced from (1); $l=\frac{f\,f^1}{l^1}$ (2), $l^1=\frac{f\,f^1}{l}$ (3).

Examples: $l=o.$; $l^1=\frac{f\,f^1}{l}=\frac{15\times 20}{o}=\frac{300}{o}=\infty$. That is when B is at the anterior principal focus F, the conjugate focus, C, is at infinity.

Similarly when $l^1=o$, C being at F^1, by formula (3) B or the other conjugate focus is found at infinity. So likewise when $l=\infty$, $l^1=\frac{300}{\infty}=o$. B then recedes to infinity and C advances to F^1.

When l is positive, to the left of F, l^1 is also positive and to the right of F^1, and *vice versa*. When, however, l^1 is negative and to the left of F^1, l is also negative and to the right of F, and *vice versa*, and both are on the same side of the principal plane A.

Examples: $l=200$ *mm.*, $l^1=\frac{300}{200}=1.5$ *mm.*, C is then positive and 1.5 *mm.* to the right of F^1 and, $20+1.5=21.5$ *mm.* behind A. Conversely when C is 21.5 *mm.* behind A, B or the far point will be 200 *mm.* in front of F, or 215 *mm.* in front of the principal plane A. This will correspond to a myopia of 4.5D.

When $l^1=-1$, C being 1 *mm.* to the left of F^1, $l=\frac{300}{-1}=-300$ *mm*, B the far point will then be 300 *mm.* to the right of F, that is $-300+15=-285$ *mm.* behind A, which represents 3.5D of H. When $l^1=-20$ *mm.*, C will find itself at A, the principal plane, and l will be $\frac{300}{-20}=-15$ *mm.* Since F A is equal to 15, B will find itself also at A, and the image and object will be superposed.

It will be seen from the examples given that a variation of 1 *mm.* in the position of C in its relation to F^1, the position of the retina in E, equals about 3.5D in the position of the other conjugate focus or far point. When l^1 is positive it is M, when it is negative it is H.

CLINICAL EXPERIENCES IN THE TREATMENT OF PHORIAS AND TROPIAS.*

By J. ELLIOTT COLBURN, M.D.

FIRST I desire to call your attention to a case of heterophoria in a neurasthenic patient with the following history:

H. M. Male, aged 35 years, decorator by occupation. Mental confusion, pain in the orbital region following or attending the use of the eyes, inability to fix the eyes for any length of time upon his work or a printed page, vertigo and scintillating scotomata. Nutrition of the body good.

Refraction:—Vision equaled $^{20}/_{60}$ in the left, $^{20}/_{200}$ in the right. Under mydriasis, left equaled $^{20}/_{70}$, right $^{20}/_{200}$. With —1. spherical combined with a —1.25 cyl. ax. 180 for the left and —1.50 spherical with a —1.25 cyl. ax. 180 for the right, vision equaled $^{20}/_{20}$ in each eye.

*Read before The Western Ophthalmological, Otological and Laryngological Society at Indianapolis, Ind., April 9, 1903.

Name, Mr. H. M.
No.

	Date	Jan. 1903					Feb.		March						
		21	22	23	25	27	4	5	6	13	14	18	19	25	
	Hyperph. R. ½	0		0			0	0	½	½	¾	1¼	0	3	0
	Hyperph, L	0		0				0							
	Esophor	9	9	5	0	0									
	Esoph. in A	0													
	Exophor	0							2½	2¼	3	2½	4		0
	Exoph. in A 3	8	8	7	8	8	8	7½	16				16		
	Abduction		2	5					7	7			8	0	
	Adduction			30					28	28			28	30	
	Sursum, R	1½											4		
	Sursum, L	1½											2		
Parallax I. st.	Hyperph														
	Esophoria	7													
	Exophoria														
	Rest Prisms	10	0	5			7	7		R.H.3 Ex. 1		R.H.1½ Ex. 1			

Grad. Tenot. Ext. Rec. O. S. — Cyclophor. neg.

Remarks: (+2)

In this case the only satisfactory reading of the muscle condition was obtained after he had been for two months under the influence of moderate doses of bromides, arseniates and extracts of malt, with out of door life and light active exercise. The patient was found to have exophoria equaling 4°, in accommodation 15°, right hyperphoria 2½° and a cyclophoria equaling —4° in the left eye.

I have long found it of advantage in the study of uncertain cases to use bromide of sodium in ten grain doses three times a day and have usually found that if true hyperphoria existed the results of the test would become uniform.

At the suggestion of Dr. Oscar King this patient was given arsenauro and fattening diet. The cyclo-exophoria was corrected by a tenotomy of the left externus when the hyperphoria gradually disappeared.

Three cases of general chorea, mother and her two daughters. There was no personal history in these cases which would indicate the cause of the condition and it was only by a study of the mother's history that I felt warranted in correcting the heterophoria in the children, hoping for a favorable result.

First Case. The mother, Mrs. C., aged 32 years, general health good from childhood with the exception of general chorea which began at her 12th year and continued with varying intensity until her 17th year, when she began to suffer from migraine and daily headaches. This condition ob-

tained until she came to me in 1893. She was refracted and at that time was relieved to a slight degree of her headaches. The attacks of migraine and occasional frontal headaches were sufficiently troublesome to have her return to me a year later for review. I then found that the glasses as first given were correct but that she showed, as she had done at the time of her first visit, a left hyperphoria of 4° with occasional diplopia when fatigued. Ten days later the error equaled six degrees, and under rest prisms used for three hours the diplopia became constant. There was no declination and no lateral errors. The left hyperphoria was corrected by a graduated tenotomy, the first result of which was a right hyperphoria of one degree, which gradually disappeared.

Three months following the operation she reported complete freedom from headache. I prescribed during the past year presbyopic correction.

Since the first operation she has used her eyes as she had never been able to do before, and without discomfort. Her general health, mental and physical, has improved.

Her two daughters began with chorea at twelve and ten years of age, though not at the same time, that is, they occurred about two years apart. Their errors of refraction were corrected, and later left hyperphoria 3° and 3½° being corrected the chorea disappeared. Up to date of writing there has been no manifestation of headache or migraine.

A troublesome feature in these cases was the frequent occurrence during the tests and at other times of transient scotomata, not scintillating, lasting from just a moment to five or ten minutes. These attacks were never, so far as I could discover, preceded by a flash of light or followed by headache, usually occurred in one eye at a time, and were incomplete and irregular in form. After the heterophoria was corrected the attacks of scotoma gradually disappeared. It is likely that the condition resembled ophthalmic migraine and later, as in the mother's case, would have become pronounced.

The value of the rest prism and the development of the latent or total error is a question which interests everyone who enters upon the study of heterophoria. The error may be manifest or latent, either in part or totally. The construc-

tion of the head, the expression, pose and history may point to an error of direction, but every test result be negative. From the fact that the results of the tests are negative I do not judge that the patient is free from muscle imbalance, but that I have not been able to discover it by the usual tests, and may never be. As we can not put the muscle at rest and have to resort to other means of determining the nature of the trouble. Rest prisms may be used to aid in the detection of the error and the determination of the degree.

We now place prisms in position to partially correct manifest or to favor the supposed error. In an hour the test is again made and the manifest condition noted. Should the prism be rejected after repeated trials I should render a Scotch verdict of not proven. If, however, the prism was not only tolerated but a slight increase, one or two degrees, accepted, a greater and greater amount may be brought out by slowly adding ½, 1, 2 or more degrees as the tests indicate, always keeping a little below the error shown at the last reading. The following case will illustrate:

Miss H. D., aged 20 years, a stenographer, had been repeatedly refracted, under atropin gave a progressive myopia —1.50 each eye. Attempts were made to relieve a troublesome asthenopia, pain in the back of the head and beginning anæmia from malnutrition. The accompanying history chart can well illustrate the method used in the study of this case. In this case the readings were taken every hour or half hour:

Name, Miss H. D. Age 20. Stenographer.
Refraction, —1.75 corrected right and left.

	Date	August 8							9			10	11	12						18		3
		A.M.						P.M.						A.M.			M	P.M.				
		9	10	10:30	11	11:30		1						9	10	11	12	1				
	Hyperph. R.	0	0	0	0	0	0	0														
	Hyperph. L.																					
	Esophor	1	3	6	9	12	16	16	16	12		16	16	16	16	16	16	16			½	½ 1½
	Esoph in A.																					
	Exodhor																			2		
	Exoph. in A.																					
	Abduction																					
	Adduction	3	3			3	3	3	2		2		2								8	8
	Sursum, R.	42	42			42		42	48	Red glass Diplopia	50		50						P. Tenot. Left Rec. Int.			48
	Sursum. L.																					
Parallax Test.	Hyperph																				0	0
	Esophoria		15			16	16						15								0	0
	Exophoria																				0	0
	Rest Prisms	1	2	5	9	11	15	0	8	0	0	15	16	16	16	16	17	16				0

Remarks: No declination. Head posed to left.

My reason for securing the total result by a single tenotomy will be found in the pose of the head and the limitation of the abduction of the left eye. Five months subsequent to the operation the young woman reported that she was free from headache and able to do her work without discomfort. The phoria was completely relieved, and rest prisms used as at the time of the visit failed to develop an error greater than at the time of the last preceding visit.

The condition of heterotropia and heterophoria or voluntary or alternating tropia or phoria I have found difficult to study and still more difficult to treat. The nearer together the refractive conditions the less difficulty in correcting the error.

Amblyopia from whatever cause always complicates the study and final judgment as to the advisability of attempting a correction after the twentieth year of age. Eccentric pose of the head, while a suggestive aid to diagnosis, is a troublesome complication, as it prevents the best results in both tenotomies and advancements.

January, 1891, Miss E., aged 20 years, was referred to me by my friend, Dr. E. I. Kerlin, for persistent headache through and back of the eyes, back of the head and in the temples. The temple and occipital pains were almost constant. From the constant discomfort her general nutrition had been lowered and she was reduced in flesh and in blood count. As no other cause for the head pain was found by the family physician, an examination of her refraction was suggested. This examination was conducted under atropin mydriasis and right hyperopia. + 50 sph., left + .75 sph. + .13 cy. ax. 90° were found to correct her errors of refraction. Left hyperphoria equaled 2°, esophoria equaled 6°. Adduction equaled 14°, abduction equaled 10°. Right sursumduction equaled 1°, left sursumduction equaled 3°. No cyclophoria (Savage test). Correction for the error of refraction was given and modified at various times during the following three months, change of surroundings, a trip to the country, tonics, etc., etc., were ordered without in any way relieving the symptoms, though she could not be comfortable without her glasses. Seven months later the hyperphoria was corrected without benefit. Later the externi were tenoto-

mized, resulting in a slight over-correction of the error equaling ½°. Glasses were again modified without relief. I now advised the patient that I was at my limit, so far as the eyes were concerned, and asked for a consultation first from an expert diagnostician and later by an ophthalmologist, if no general cause was found. During a general physical examination it developed that both kidneys were afloat and that after manipulation the patient was free from pain and discomfort, only to relapse as she moved about. This was a failure not of diagnosis and treatment of ocular errors, but of diagnosis of the conditions causing the nervous symptoms. Up to my last knowledge of the patient nothing had been done toward fixing the kidneys, and the patient is still a sufferer from eye strain symptoms. One other case of floating kidney has come under my observation with symptoms simulating eye strain.

Complete Tenotomy for the Correction of a Phoria. Mr. M., aged 28 years, was referred by a neighboring practitioner with the following note:

The patient is coming to Chicago to make it his permanent home.

"I am referring a Mr. M. to you for the correction of a left hyperphoria, which was originally a left cataphoria, but owing to the slipping of my sutures the present condition resulted. The patient had 18 degrees of cataphoria at first and desiring to test the method proposed by an eastern ophthalmologist of cutting the tendon completely off in cases of four degrees or more, and thinking I was safe with that large amount, I followed the suggestion, with about six degrees remaining, but this gradually passed over to twenty-four degrees of the present trouble. I then attempted to advance the inferior rectus and got a good result, but the tissue did not seem to unite readily and my sutures were slipping, so I weakened the superior. The correction was only temporary when the hyperphoria gradually returned, and as a last resort I again advanced the inferior, but my sutures again slipped and the union was slow."

When the patient came to me, as nearly as I could make out, he had on the perimeter 24° (geometrical) of L hyperphoria. The thickening resulting from the last operation had not fully disappeared, but it was not until I had opened

the conjunctiva that I realized that it would have been better to have delayed the operation until a later date. My attempt to secure the muscle in its proper position proved a partial failure, as in January just past I found 20° (prism) of error remaining, but by posing his head he was able to secure single vision. In January last I was able to reattach the muscle, leaving but one degree of left hyperphoria.

I can not from a personal experience condemn complete tenotomy for the correction of a phoria. I can only say that I do not feel justified in attempting it nor would I attempt a tenotomy of the inferior, either partial or complete. I have found it difficult to guage the effect of an operation on the inferior muscle. Stevens has pointed out the difficulties attending operations on these muscles. In my opinion from what I know of this class of cases an advancement is the better operation. While more difficult, the results are positive and, if properly executed, satisfactory.

Mr. L. K., aged 24 years, a student, had been refracted under atropin. Glasses had been prescribed and frequently changed. The asthenopia headache and general neurasthenia were in no way benefited, though he could not work without his correcting glasses.

Right +1.

Left +1. with +.75 cyl. ax. 90°.

A diagnosis of hyper-esophoria equaling $4'\llcorner 8°$ had been made and prisms given for its correction. With all this there was no lessening of his symptoms, and a year of out of door life was advised. As this would delay him in obtaining his degree he came to me in consultation. I found refraction and muscle imbalance as reported and advised a tenotomy for the correction of the hyperphoria and later the esophoria. The case was further considered and ten days later found a hyperphoria of 8° with a varying esophoria. Without the correction of the error of refraction I could not make out a declination either by Stevens or Savage tests.

A graduated tenotomy of the right superior rectus was done and an immediate measurement taken. There was but slight change in the phoria. Another investigation was made and it was found that a central band far back had escaped the Stevens hook. When this was severed an over-correction

was obtained which necessitated the use of a restraining suture to prevent too great a displacement, as I desired to advance the muscle in the fellow eye. In this case the muscle was heavy in its center and the lateral wings were thin and unusually broad. The check band which prevented the recession of the muscle was thin and unusually broad in its ocular attachment.

The vertical plane of the right eye was nearly the same as that of the plane of the face, five degrees, while the corresponding plane of the left eye was thirty degrees, the normal in a symmetrical face being fifteen degrees. Plane B, see the *Journal of the American Med. Assn.*, Oct. 18, 1902. (Fig. 1).

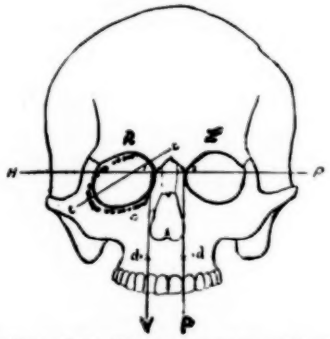

FIG. 1.—H P, Horizontal plane; 1, 2, attachments of the orbicularis palpebrarum; V P, verticale plane; d, d, canine fossa; c, c, direction of largest diameter of the orbit.

In operating, particularly for the lateral errors, I have found it best to pay full respect to the total error as shown by the rest prisms, correcting it by advancement or tenotomy.

For the correction of cyclophoria I prefer in low degrees associated with hyperphoria the graduated tenotomy, while in high degrees of declination the advancement after Stevens' method, or as preferable to anchor the muscle to the tendon of the adjacent wing of the rectus muscle.

Mr. G., aged 32 years, had been examined and error of refraction corrected under atropia used four or five days. There was great difficulty experienced in correctly locating the axis of a low cylinder for the right eye, it being alternately received at 90, 75 or 105 degrees. There was a slight exophoria at twenty feet and pronounced exophoria at the proximal point. A minus cyclophoria of five degrees was con-

stantly observed under the Savage test. There was distortion of the page with correction before the eyes and alternate acceptance and comfort, and rejection and discomfort with the lenses at 90 degrees.

After some weeks observation, ocular gymnastics and general ocular rest the patient was operated after the Stevens method and the glasses accepted at 90 degrees without return of asthenopia or headache. In this case there had been in the later hours of the day a facial tic which has completely disappeared.

My first experiences with the Stevens method were not markedly successful, as I did not appreciate the importance of placing the stitch in the stronger portion of the annular ligament.

It seems to me important to call attention to the fact that heterophoria in any form can not be studied or treated without the exercise of extreme patience, whether they prove to be operative or non-operative cases.

Dr. H. S. B. I called attention to this patient in June, 1902, at the meeting of the American Medical Association, and herewith offer the report then made and the supplementary report:

Case 4.—Mr. B. Aged 24, robust general health, sturdy physique, has from early childhood suffered from headache, periodic asthenopia usually during school terms and has attacks of petit mal, but during the past three years these have been infrequent as he has been engaged in active out-of-door life. His military training has forced him to hold the head in nearly the primary position. He is always conscious of an effort to secure and maintain binocular single vision. With the slightest effort diplopia results and the disengaged eye either turns upward and outward or downward and outward, as the case may be, to a sufficient degree to rid the patient of the confusion of double vision. I have never been able to satisfactorily estimate the total error. Refraction R, V$=^{20}/_{20}$, L, V$=^{20}/_{20}$. Atropia R, +1.$=^{20}/_{20}$, L, +.75$=^{20}/_{20}$. Head in primary position, field of fixation normal, adduction =26, abduction =16. R sd. =? L sd. =? Orbital planes: Right eye plane A 25, plane B 20, declination =25. Left eye plane A 12, plane B 10, C 15. You will observe that the plane A

FIG. 2.—A. P. Left orbital angle; A. F. right.

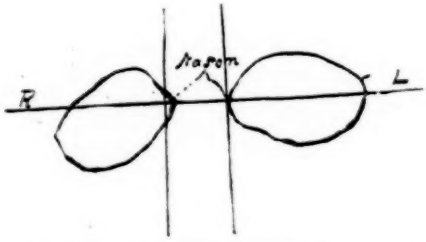

FIG. 3.—Non-symmetrical position of bases of orbits.

(Figs. 2 and 3) in the right eye has a greater angle by 13 than the left, and the plane B is greater by 10 (Figs. 4 and 5). We would class his head as broad and flat if viewed from the right side; if viewed from the left side, long and thin. When attention is relaxed the habitual pose of his head is to the left with

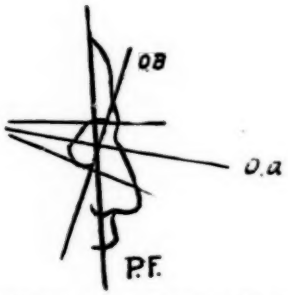

FIG. 4.—Right side of face; P. F. vertical plane of face; O. A. orbital axis; O. B. orbital base.

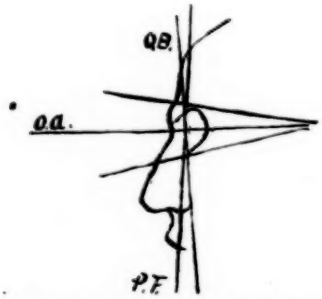

FIG. 5.—Left side of face; P. F. vertical plane of face; O. A. orbital axis; O. B. orbital base.

the chin depressed. An effort was made about six years ago to correct the hyperphoria by a graduated tenotomy and advancement, but shortly after the tenotomies were made the patient was called into active service and the error has not been taken under consideration until quite recently.

The status of the case when he came to me again in the autumn of 1902 was as follows: Head in primary position. Perfect parallelism. Red glass showed left hyperphoria of nine degrees which quickly passed twenty degrees. Exophoria equalled 14°. Could fuse by effort and fix with the left eye and the right would assume the hypophoric position equaling 9°. The Maddox rod, Stephens phorometer or parallax test gave about nine degrees of left hyperphoria. A partial tenotomy of the superior rectus reduced the error to 7°, and two months later an advancement of the right superior rectus gave perfect correction of the hyperphoria. Three months later a partial tenotomy of the right externus and an advancement of the right internus corrected the exophoria, giving him two degrees of esophoria.

In this case tenotomies in themselves were of little use. The advancements only were of avail. It must take months of careful use of the eyes to do away with the bad habits of fixation and the disturbance of the nerve centers governing the recti muscles. Training the muscles, by prism or other exercises, does not count for much. They have the power to overcome high prisms, but the effort resulting from sustained fixation under difficulties resulting from asymmetrical formation and direction of the orbits is too great even for well-trained nerve centers and muscles.

The basis for the error in this case was undoubtedly anatomical. And while an unusually sturdy physique and nervous make-up enabled him to do a large amount of work, yet with each added year he realized the increasing labor and discomfort of the handicap.

DISCUSSION.

Dr. Ferd C. Hotz, Chicago.—The diagnosis and management of phoria cases is certainly one of the most perplexing problems oculists have to deal with. As the descriptions of the essayist of his careful and persistent examinations show, we cannot come to a conclusion in such cases by one or two examina-

tions. There are so many points to be considered in relation to the muscles of the eye, as to whether they are a disturbing element; whether the discovered phoria is a real thing and one that we can change. That alone requires great care and patience and perseverance to find out; and before we have satisfied ourselves that it is actual, we certainly have no right to interfere, especially by the mechanical means of an operation. With our present facilities we can certainly discover phoria in almost every patient, just as we can discover a refractive error in almost every eye. The question is: Is the phoria a source of trouble, an etiological factor in the complaints of the patient? If a doctor limits his observations to the eye and works out phoria only, without taking into consideration the numerous other conditions of the nervous system and of the whole body in every way, he is apt to encounter dangerous pitfalls and make most serious blunders. I wish to relate a few such observations which are most instructive to me. To the younger members it should be a warning not to look at the eye with blinders on.

Some time ago a college student consulted me with the history that he had been suffering with asthenopia, for the relief of which he had been submitted to three or four graduated tenotomies, but without relief. There was some esophoria present, two degrees. Both eyes were myopic. The fundus showed marked irritation of the choroid. I put him on a rest cure under atropine, and in four or five weeks he was able to use his eyes with ease.

Another case shortly afterwards in my clinic was that of a patient with slight paresis of the externus of the left eye. He said that three months before a tenotomy of the superior rectus had been performed on that eye—for the correction of what I do not know. The man had apparently perfect health, was strong, robust and intelligent. I made the remark to my class that a paresis of an ocular muscle coming on in a man of middle age in apparently good health, where we have no traumatism and no specific history, always ought to induce us to investigate as to the possibility of beginning locomotor-ataxy. When I made this man stand up with his eyes closed, he began to sway in a few seconds, so that he would have fallen had not the students supported him. The knee-jerk was entirely gone. The diag-

nosis of locomotor-ataxy was confirmed. In that case, operative interference with whatever might have been the matter with the superior or inferior rectus was absolutely uncalled for. But some doctors are sometimes so absorbed in what they see in the eye that they forget that the eye is, after all, not disconnected from the rest of the human body.

Dr. W. L. Dayton, Lincoln, Neb.—With all honor to my friend Dr. Hotz, who, I think, is an anti-phorist, I will say that I certainly believe in phorias. I feel just so sure as we can have talipes, that we can have an insufficiency of the ocular muscles. Patients certainly come to us with asymmetrical faces, and in these cases we frequently find shortening of one muscle, or one set of muscles, or insufficiency of several sets. The question is, what shall we do, not, whether this condition exists. The question is whether the thing to do is a tenotomy or treatment of the systemic conditions. The question is as to the remedy to provide. I have served a rather long apprenticeship in graduated tenotomies, and I have advanced, resected and done several other methods in order to correct the condition I have found existing. I can certainly say that there is no operation I have found that will answer in all cases. We must select our cases for graduated tenotomies, resections and advancements.

Dr. Hotz.—It is a great surprise to me that my remarks were interpreted as my being opposed to operative treatment of heterophoria. This was not the purpose of my remarks. I cannot cover the entire ground in the few minutes allowed, but I simply took up one point in voicing a few words of caution. I fully acknowledge the existence of heterophoria. I am treating such cases and am not opposed to operation where needed.

Dr. Colburn (closing discussion).—I do not know that I have anything to offer in reply, as there has been, so far, no criticism of my statements. I do not feel like criticising the operation of complete tenotomy for heterophoria. I have never practiced it myself and do not know the results, but I would criticise the tenotomy on the inferior rectus muscle. You cannot estimate the effect of either advancement or tenotomy, and I would warn any one from touching in any way the inferior rectus muscle.

THREE ESSENTIAL POINTS IN THE OPERATION FOR CICATRICIAL ECTROPIUM.

By F. C. HOTZ, M.D.,
Prof. of Ophthalmology and Otology in Rush Medical College, Chicago.

SOMEBODY once has said blepharoplastic operations look very pretty—on paper, but in reality the results are anything but pleasing and satisfactory. The operations for cicatricial ectropium are not excepted from this criticism. The restored lids often look hideous, and still oftener are everted again after a few weeks or months. But we can overcome these drawbacks, if we pay strict attention to the following points:

1. The proper division and fixation of the skin flaps.
2. The selection of the most suitable material for covering the lids.
3. The shortening of the overstretched lid border.

1. *The Proper Division and Fixation of the Skin Flaps.* The greatest difficulty we have to contend with in the operations for cicatricial ectropium, is the tendency of the shrinking skin flaps to evert the lids again. As all transplanted flaps will undergo more or less shrinkage and as the lid border is least capable of offering any resistance to the traction of the shrinking flap, a re-eversion of some degree is almost inevitable as long as the transplanted flap is attached to the non-resisting lid border on the one side and to the non-yielding skin of the forehead or cheek on the other side, because the lid border is then exposed to the full traction force of the shrinking flap. It is evidently much easier for this flap to pull the lower lid down than to draw the skin of the cheek up, and therefore re-eversion is an especially common occurrence after the operation for ectropium of the lower lid.

It is plain, then, that to prevent the re-occurrence of ectropium we must place the lid border beyond the reach of this traction force. And this can be accomplished if instead of covering the whole wound with one skin flap we make use of two flaps, a small one which is to cover the lid surface only and which we will call the *lid flap*, and a larger one which is to be spread over the remaining wound area; and furthermore if we make provision that the contraction of the larger flap can have no effect upon the lid flap.

In ectropium of the upper lid this point is gained if the

upper edge of the lid flap (Fig. 1 ba.) is firmly attached to the upper border (a) of the tarsus, while its lower edge (b) is united with the free margin. The lid flap is thus anchored above and below to the tarsus and its contraction cannot turn the lid over because to do so the traction force must have a fixed point of purchase outside of the lid. The shrinkage of the other skin flap (ac) which has its point of purchase (c) outside of the lid, however, cannot disturb the position of the lid margin, because its pulling force is expended entirely on the upper tarsal border (a); for, thanks to its firm union with

FIG. 1.

this border, the lid flap cannot be stretched or drawn upward by the contraction of the other flap and as as long as the lid flap cannot be drawn up, the lid border is effectally guarded against re-eversion.

In ectropium of the lower lid, the same principle is adopted for the protection of the lid against the vicious traction of the shrinking flap. But we must bear in mind that the tarsus of the lower lid is very small and narrow and that normally the lid skin reaches farther down than the lower border of the tarsus, to a slight furrow a little above the infraorbital margin, (Arlt's tarso-malar furrow) where the integument passes from the upright plane of the lid into the sloping sur-

face of the cheek. This normal boundary line between the lower lid and cheek must be re-established by our division and fixation of the skin flaps; and the lid flap (dg) therefore must not be united with the lower border of the tarsus, but fastened to the tarso-orbital fascia (at g) in a line a little above the infraorbital margin. As the fascia is, as it were, the anatomical continuation of the tarsus, the lid flap adherent to the surface of the tarsus and fastened to the fascia cannot evert the lid. And the shrinkage of the large flap (ge) covering the wound of the cheek, is prevented from pulling on the lid margin and causing re-eversion of the lid, because its traction cannot reach beyond the firm union of the lid flap and fascia. So strong is the resistance of this union that you may draw the skin of the cheek down as much as you please and you will not succeed in everting the lid.

2. *The Selection of the Most Suitable Material for Skin Flaps.* If it is our ambition to obtain the best possible results in ectropium operations—and nothing less ought to satisfy us—we cannot be contented with the mere reposition of the lids, but should strive also to restore as much as possible their natural appearance. The lids contribute more to the expression of the eye than the eyeball itself; and the slightest alteration of shape and outlines, or the least impediment of motion seriously mars the expression of the face. This is a very important point and should always be taken into account when we choose the material for our flaps. The normal integument of the lids is a thin and delicate skin of such perfect flexibility and adaptability that it allows perfect freedom of motion and accommodates itself readily to the numerous slight changes in contour so characteristic for the various facial expressions. In order, therefore, to gain a perfect cosmetic result we must select as a substitute for the lost lid skin, a material which possesses the same qualities; it must be thin, light and adaptable. It goes without saying that the thick skin of the forehead, temples or cheek does not possess these qualities; and therefore flaps from these regions should not be transplanted upon the lids. Besides the transplantation inflicts additional wounds upon the face and I hold we should avoid marring the face by unnecessary scars. The use of Wolfe's flaps taken from the arm avoids this latter objection, but they, too, are usually so thick that like the peduncle-

ulated flaps, they make a heavy, clumsy-looking lid. These two kinds of flaps are as well suited for a substitute of lid skin as shoe leather would be for kid gloves.

A good and suitable material for lid flaps which answers all the requirements is the cicatricial skin usually found in the immediate vicinity of extensive ectropium. I have shown in 1896* that this skin can be successfully transplanted and makes a perfect lid skin. In ectropium of the lower lid this cicatricial skin can nearly always be utilized for the lid flap. In ectropium of the upper lid it can sometimes be used when the eyebrows are absent. If on account of the eyebrows the cicatricial skin is not available, a Thiersch graft is the only suitable material. It accommodates itself to the surface of the lid, brings out its contours perfectly and does not in the least interfere with the free movements of the lid.

3. *The Shortening of the Elongated Border of the Lower Lid.* As the diameter is shorter than the half circle, so in the case of complete ectropium the free lid margin of the lower lid turned from its almost straight line between the canthi into a long downward curve is elongated a good deal; and after being held in this abnormal state for a long while it will not recover its normal length when the lid is replaced. The elongated margin of the lower lid will not closely fit the curvature of the eyeball and will drop away from it, as in a senile ectropium. The reposition of the everted lower lid, therefore, cannot be perfect and permanent, unless the overstretched lid margin is reduced to its proper length. In several instances I did not do that, because the lid margin appeared to lie in perfect apposition to the globe; but every time I had cause to regret this omission and had to correct my mistake by a second operation. I, therefore, regard the shortening of the elongated border of the lower lid a very essential point in the operation for cicatricial ectropium.

And now, after having so strongly emphasized the importance of these several points, I wish to indicate briefly the plan of operation based upon the views expressed in the foregoing remarks. As the operation is not alike in details for both lids, I believe it is better for a clear understanding to describe the method for each lid separately.

*Journal of the American Medical Association, September 19, 1896, and Archives of Ophthalm. Vol. 25, No. 3.

Technique of the Operation Upon the Upper Lid. If the eyebrows are partly absent and there is a good expanse of cicatricial skin above the everted lid, we cut from this cicatricial skin the lid flap in the following manner: *"From a point (a Fig. 2) about 5 millimetres above the inner canthus

FIG. 2.

an incision is made obliquely upwards into the cicatricial skin and then continued in a curve downwards to a point (c) about 5 millimetres from the external canthus. This incision outlines a large flap (abc) which is carefully dissected up from

FIG. 3.

the underlying scar tissue as far as the lid border. The lid is then released by dissection from all cicatricial connections until it can be easily turned down into its normal position; and now the edge (Fig. 3 ac) of the lid flap is fastened by silk sutures to the upper border of the tarsus."

*Archives of Ophthalm. Vol. 25.

If, however, on account of the eyebrows the lid flap cannot be taken from the cicatricial skin, we make an incision along the lid border and after the reposition of the lid cut from the arm a Thiersch graft of suitable size which is transported on the razor directly to the lid, spread out over its surface and fastened by fine silk sutures to the upper tarsal border as well as to the wound edge of the free border. These sutures must be inserted with great care to make sure the edges of the flap do not roll in; their application therefore is very tedious work; but the time is well spent because the graft thus fixed is positively secured against being shifted from its place by any movement of the lid or by any accidental displacement of the dressing. After the

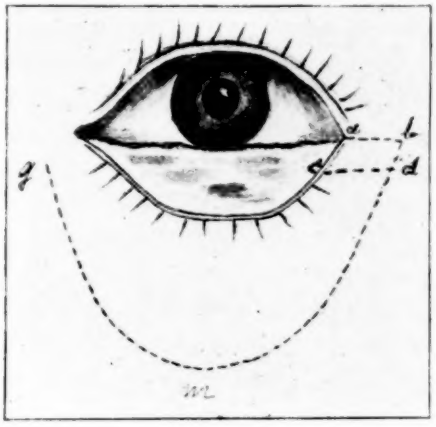

FIG. 4.

lid flap is fastened (as in Fig. 3) the lid is drawn down as far as possible and held in this position by two ligatures passed through the free border and fixed on the cheek by plaster strips. This is done for the purpose of immobilizing the lid during the healing process and also for enlarging the wound (a, b, c), above the lid to its fullest capacity. Over this wound a Thiersch graft is spread out so that its edges lap over the surrounding skin; no sutures are used.

TECHNIQUE OF THE OPERATION ON THE LOWER LID. Here the lid flap can always be procured from the cicatricial skin; but as this skin shrinks considerably as soon as it is dissected up we must take good care to cut the flap of very liberal dimensions. We begin the incision one centimetre below the inner canthus (Fig. 4g), carry it obliquely down into the cheek to a point (m)

2 to 3 centimetres below the centre of the everted lid margin; then we continue it in an oblique direction upwards and outwards to a point (b) even with and one centimetre from the outer canthus. This large flap (gmb) is then dissected up from the underlying scar tissue and all cicatricial strands and bands are cut until the lid is freed and can be turned up. The next step is to reduce the overstretched lid margin to its proper length by removing a suitable piece of the lid (except the conjunctiva) near the outer canthus by the following incisions: from the canthus (a) transversely to (b), from (a) to (c) along the lid margin, and from (c) to (d) through the flap; the edges (cd) and (ab) are then united by two silk sutures. Now the lid is drawn up as far as possible and held in this position by two silk ligatures passed through the free margin and fastened on the forehead by adhesive plaster or collodion. This done the edge of the lid flap is anchored to the tarso-orbital fascia by silk sutures (Fig. 5). The lid flap should be evenly

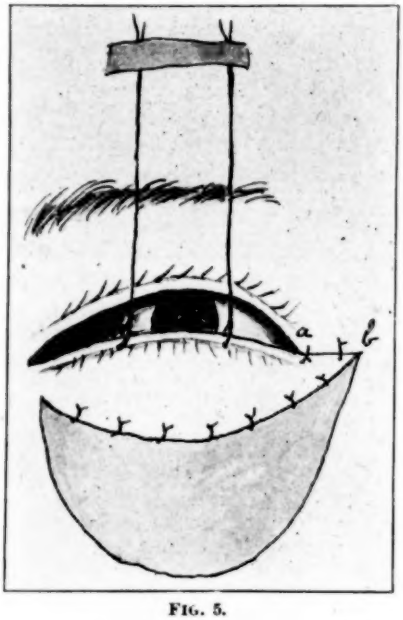

FIG. 5.

spread out, so as to be in perfect contact with the wound surface; but we must carefully avoid any undue stretching; and should we find that the flap is a trifle short and would be stretched if the sutures are placed very near the infraorbital margin, it is better to put them through the fascia 1 or 2 milli-

metres higher up. Finally the wound surface (gmb) below is covered with a Thiersch graft the edges of which are made to lap over the surrounding skin. No sutures.

THE AFTER TREATMENT is the same for the upper and lower lid. Strips of gutta percha protective are laid over the flaps, and upon these strips a gauze compress wrung out of warm boric acid solution; this is covered by a large, square piece of protective to prevent evaporation and over this is put a layer of cotton to maintain uniform warmth. This whole dressing is secured in place by a roller bandage and best left undisturbed for three days. Then it is carefully removed; the flaps are thoroughly cleansed, the overlapping edges of the large flap are trimmed off and a new dressing is put on which is changed every day or two as circumstances may require. At the end of the first week the ligatures and the sutures of the lid may be removed; during the second week some simple ointment (like borated vaseline) is applied daily on the flaps and after this period no further treatment is required.

DISCUSSION.

DR. CASEY WOOD.—I feel a debt of gratitude to Dr. Hotz for his suggestions in the surgery of the lid. The main thing in his experience of grafts is the selection of the skin. Dr. Hotz suggests that grafts be taken from the arm. If a Thiersch and not a Wolfe graft be employed, I endorse that statement. If the directions to use a Wolfe graft are followed, it must be remembered that the hair of our bodies is removed or its growth reduced to a minimum by the rubbing of our clothing. If one remove the thin and apparently hairless skin of the anterior aspect of the arm and transplant it to the face, it, no longer repressed by the friction of the clothing, will develop a magnificent growth of hair and the patient will be obliged to constantly pull them out. This was exemplified in a case operated on by the speaker for the restoration of the lower cul-de-sac. It is now hoped that the artificial eye, the patient will soon wear, will keep the hair down. In another case where an angioma the size of a butternut was exercised from the lower lid of a child 2 years old, the skin removed at that time involved the whole length of the lower lid, and to replace it a Wolfe graft was used. It took nicely, but now there is a large, white, thick patch, resulting from the transplantation, to deal with, however successful it has

been and however useful it is. The speaker in nearly all cases discards the Wolfe graft and advises the Thiersch, which answers all requirements and avoids the inelegant appearance following the thicker grafts from whatever part of the body they are taken.

Dr. Oscar Dodd, Chicago.—I was very much pleased to hear this paper by Dr. Hotz, and especially the suggestions as to the anchorage of the grafts of the lower lid to prevent retraction. In the upper lid I have never had any trouble in using Thiersch grafts, and that is the only form I use in that region, unless the whole thickness of the lid, with the conjunctiva, is removed with the tumor. In the lower lid I am not always able to get tissue of the size that can be transplanted. In two of my cases the burn was so deep, there was nothing but dense cicatricial tissue adherent to the periosteum, and all I could do was to bring tissue from outside to form the lid. Thiersch grafts I have found useless in these cases. Perhaps by anchoring, the method Dr. Hotz describes, I may be able to obviate the difficulty. The Wolfe graft, if prepared very thin, I have found of benefit, but it has the disadvantage that it is never like the skin of the face or lid, and will remain—at least, for years—of a different color and can be distinctly seen. As for pedicle grafts from the temple and cheek, I do not feel as Dr. Hotz has stated, that they should never be used. I think there are cases where it is impossible to get as good results as we wish in the restoration of the lids without them.

Dr. Geo. F. Suker, Chicago.—Dr. Hotz's operation is certainly admirable. He laid emphasis on the contraction of the flaps not taking place, which is the all important factor. It occurred to me, however, that if he did not have the exact coaptation by not having the upper flap overlap the lower, but left a narrow line of granulating surface between the flaps, he would avoid all depression or contraction. I agree as to the Thiersch graft. I had a disagreeable experience not long ago in transplanting a Wolfe graft, as now the patient has to shave his lid.

Dr. Derrick T. Vail, Cincinnati.—This is a subject which appeals to us all. We have seen the various forms of ectropium due to cicatricial changes following burns and neoplasms about the eyelids. The ingenious method of Dr. Hotz certainly will

cover many of the cases we have to treat. I wish to compliment him on his ingenuity and originality in devising the double flap and wish to inquire if it is original.

Dr. Hotz.—So far as I know.

Dr. Vail.—It is a valuable contribution to the art of plastic surgery of the eyelids and I think will prove to be of great help in the surgical treatment of cicatricial ectropium. I have never used it, but have used his old operation for ectropium with fairly satisfactory results.

There is one kind of ectropium of which I have seen two cases within eighteen months, where his double flap operation would not, perhaps, be applicable. I refer to that form of ectropium which involves the inner canthus of both eyes; where the skin of the nose has been burned off, followed by cicatricial contraction and the inner canthus of each eye is drawn so badly toward the median line of the nose that there is only a small space between them on the bridge of the nose. This generally concerns both eyes. I met this condition with the suggestions laid down by Dr. Hotz in his former operation. I restored the lids to the eyeball and also restored the patulency of the lachrymal ducts, laying in a nice transplanted flap, but the operation was a failure. The cause of the failure I learned by the experience afforded by the operation. In restoring the lids to the eyeball at the inner canthus, you have a crescentic exposure of the fascia, and it would seem that a piece of skin laid in there would give satisfactory results, but it will not. To have a good result it is necessary to anchor the upper lid to the lower lid at the inner corner of the eye in such a way that you really have an involution of the canaliculi and puncta to allow for contraction changes. The main thing about the whole operation for cicatricial ectropium in general is in following the suggestion Dr. Hotz has made about *taking up the slack of the lid* and unless you take away fully a third of the lower lid at the outer canthus your operation will be a failure.

Dr. Albert E. Bulson, Jr., Fort Wayne, Indiana.—It is my experience that the annoyance from the presençe of hairs in the skin grafts, already mentioned, may in a very large measure be overcome by taking the grafts from behind the ear where the epithelium contains fewer hair follicles. These grafts prove more satisfactory than grafts taken from any other part of the

body, but it is not always possible to secure grafts of sufficient size to cover large surfaces and then resort must be had to epithelium from some other part. In the majority of operations around the eye, grafts of sufficient size, taken from behind the ear, can usually be obtained.

Dr. J. M. Ray, Louisville, Ky.—I presume all the members of this Association listen with interest to what Dr. Hotz may say about the plastic surgery of the eye and eyelid. I have done a certain amount of this work myself and I find it a great advantage, when I transplant flaps, to first bare the edges of the lids and sew them together. I did this in one case with a large Wolfe flap, a very small portion of the flap grew, but by having the eyelids sewed together, I later transplated Thiersch grafts and eventually covered the surface. I then separated the lids and a good result followed.

Dr. Hotz (closing discussion).—I was glad to hear Dr. Wood's observations. Whether I am correct or not, I emphasize the careful selection of the proper materials. (Dr. Hotz showed photographs of cases operated on by other methods with unsatisfactory results.) Cut Thiersch grafts as thin as possible—just the epidermis—just deep enough to get live cells and not hair follicles. Do not transplant hair follicles and you will not have hairs in the flaps. If in the lower lid cicatricial tissue is not available, I would use Thiersch grafts. I have done the operation a number of times, otherwise I would not present it to you. I could show you in Chicago a number of cases. The upper lid moves nicely and shows the deep characteristic furrow. Dr Suker seems to have misunderstood what I said in regard to allowing the upper flap to overlap. This is done to prevent the rolling in of the flaps, as Thiersch flaps have a tendency to roll in. So fastened, they will not do it. In changing the bandage, the overlapping portion is simply pared off. I forgot to mention that. To leave a granulation line along here would have no advantage. If we fasten the flap firmly to the tarsus we know it will unite. If we leave it to granulations, we trust to uncertainties.

(Just at this time a patient, whom Dr. Hotz had formerly operated on, chanced to call, and thus the Doctor was afforded an opportunity to present the case for inspection to the Academy and to show the perfect cosmetic result obtained by his operation).